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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/604,594

08/01/2003

Hiroyuki Akatsu

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EXAMINER

NGUYEN, KHIEM D

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 02/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/604,594

Applicant(s)

HIROYUKI AKATSU

Examiner

Khiem D Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 08 November 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 4-7, 10-15 and 17 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 4-7, 10-15 and 17 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 August 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4-7, 10-15, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kudelka et al. (U.S. Patent 6,426,254) in view of Birner et al. (U.S. Patent 6,660,582).

In re claim 4, Kudelka discloses wherein the trench 110 is formed by anisotropic etching (col. 4, lines 24-27 and FIGS. 1-8).

In re claim 5, Kudelka discloses wherein the trench 110 is widened by isotropic etching using a chemistry including an HNO<sub>3</sub> /HF mixture (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and FIG. 8).

In re claim 6, Kudelka discloses wherein the trench is widened by anisotropic etching using a chemistry selected from the group consisting of wet alkaline chemistry and NH<sub>4</sub>OH (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and FIG. 8).

In re claim 7, Kudelka discloses wherein the trench is deepened by anisotropic etching (col. 4, lines 24-27 and FIGS. 1-8).

In re claim 10, Kudelka discloses a method of providing a trench capacitor on a semiconductor substrate 102, comprising: forming a pad stack 101 on a semiconductor substrate; forming a hard mask 108 over the pad stack; patterning the hard mask 108 and

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the pad stack **101** to form an opening; vertically etching the substrate through the opening to form a trench **110**;

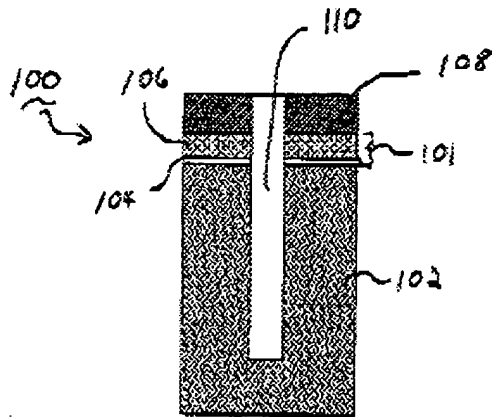


FIG. 1 (Prior Art)

horizontally widening sidewalls of the trench **110** (col. 4, lines 29-46 and FIGS. 1-17); widening sidewalls of the opening in the pad stack and the widened sidewalls of the trench; forming a sacrificial collar **116** on the widened sidewalls of the trench; vertically deepening the trench to create a lower portion **125** extending below the sacrificial collar **116**; and forming a capacitor in the lower portion (col. 7, lines 4-16 and FIGS. 8-12).

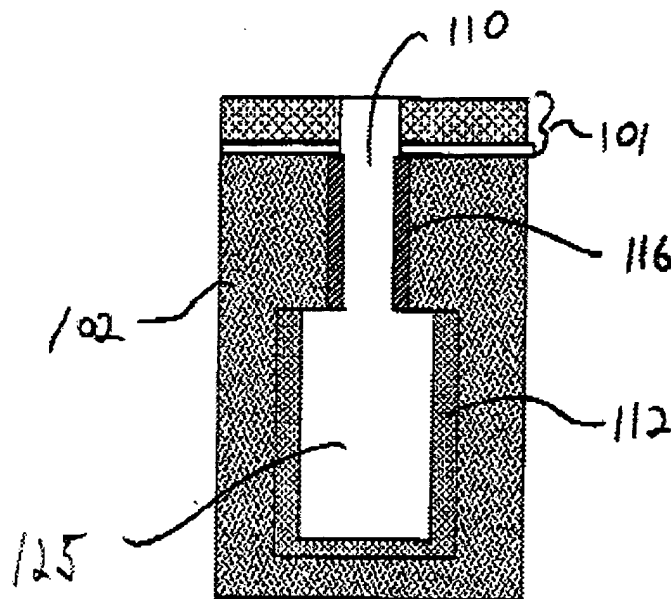
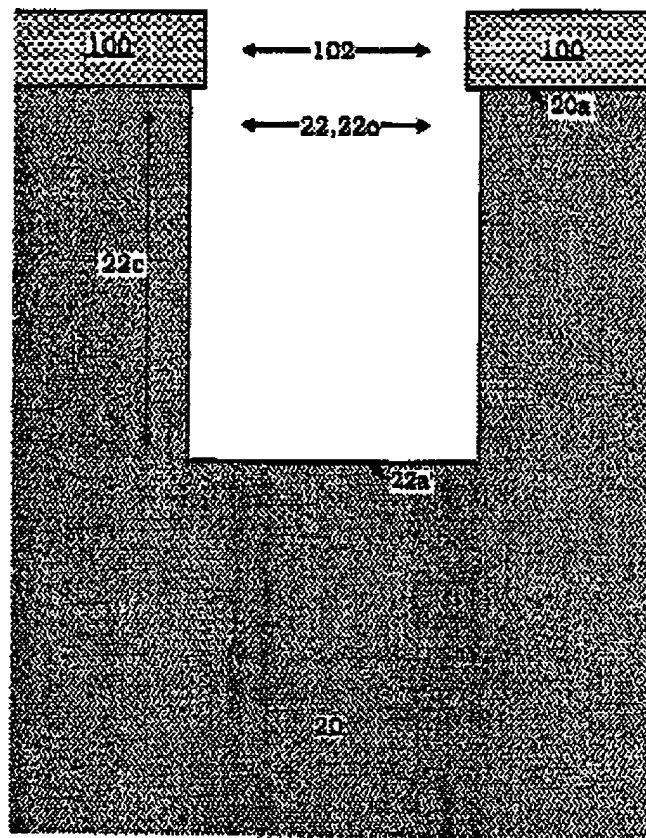


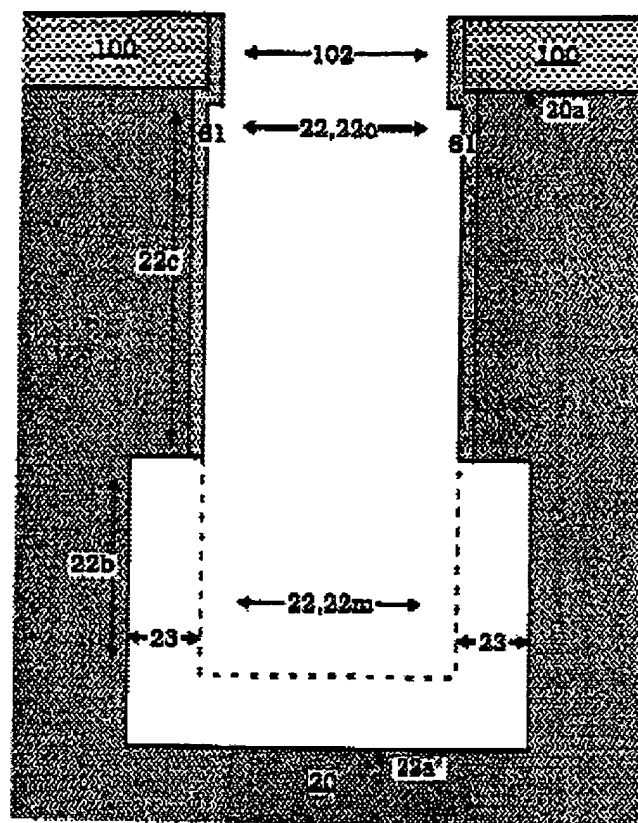
FIG. 8

As disclosed in col. 4, lines 28-47, in an alternate embodiment, trench 110 is widened using a wet anisotropic etch process. In this alternate approach, hard mask 108 is employed to locate trenches 110 and after trench 110 is formed the trench sidewalls in the pad stack is widened relative to the hard mask by the etch process. Thus, by widening the trench sidewalls in the pad stack, the hard mask 108 inherently having an overhangs portion over the widened sidewalls of the trench.

Additionally, Birner et al. disclose selectively widening sidewalls of the opening 102 in the pad stack relative to the hard mask such that the hard mask 100 overhangs the widened sidewalls of the opening 102 in the pad stack (col. 8, lines 10-32 and FIGS. 1-20).



**Fig. 4**

**Fig. 7**

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kudelka and Birner to enable the hard mask of Kudelka that overhangs the widened sidewalls of the opening in the pad stack to be formed and furthermore the undesired instances of contacting of neighboring components of highly integrated circuits can be prevented in a simple way (col. 1, lines 60-62, Birner).

In re claim 11, **Kudelka** discloses wherein the pad stack 101 comprises a pad nitride layer 106 overlaying a pad stop layer including an oxide 104 (col. 4, lines 6-27 and FIGS. 1-8).

In re claim 12, **Kudelka** discloses wherein the hard mask 108 comprises an oxide layer selected from the group consisting of a tetraethylorthosilicate (TEOS) deposited oxide layer and a borosilicate glass (BSG) deposited oxide layer (col. 4, lines 53 to col. 5, line 3 and FIGS. 1-8).

In re claim 13, **Kudelka** discloses wherein the sacrificial collar comprises a layer of nitride (col. 4, line 53 to col. 3 and FIGS. 1-8).

In re claim 14, **Kudelka** discloses wherein the sacrificial collar 116 further comprises a layer of oxide contacting the widened sidewalls under the layer of nitride (col. 4, line 53 to col. 5, line 3 and FIGS. 1-8).

In re claim 15, **Kudelka** discloses wherein the method of Claim 10 further comprising widening the lower portion 125 by an isotropic etch to achieve a bottle-shaped structure prior to forming the capacitor (col. 4, lines 29-47, col. 5, line 61 to col. 6, line 12, and FIG. 8).

In re claim 17, **Birner et al.** disclose wherein the opening 102 in the pad stack is widened at the same time that the sidewalls of the trench are horizontally widened (col. 8, lines 10-32 and FIGS. 1-20).

***Response to Applicant's Amendment and Arguments***

Applicant's arguments filed November 8<sup>th</sup>, 2004 have been fully considered but they are not persuasive.

Applicants contend that the invention as recited in claim 10 is neither taught nor suggested by Kudelka or by the combination of Kudelka with Birner. Particularly, Applicants stated that Kudelka neither teaches nor suggests a process as recited in claim



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10 in which, after the trench is widened, steps are subsequently done to form a sacrificial collar on the widened sidewalls and to vertically deepen the trench to create a lower portion extending below the sacrificial collar.

In response to Applicants' contention that Kudelka neither teaches nor suggests after the trench is widened, steps are subsequently done to form a sacrificial collar on the widened sidewalls and to vertically deepen the trench to create a lower portion extending below the sacrificial collar, Examiner respectfully disagrees. Applicants are directed to (col. 4, lines 29-46 and col. 7, lines 4-16 and FIGS. 1-17, Kudelka) where Kudelka discloses horizontally widening sidewalls of the trench **110**; widening sidewalls of the opening in the pad stack and the widened sidewalls of the trench; forming a sacrificial collar **116** on the widened sidewalls of the trench; vertically deepening the trench to create a lower portion **125** extending below the sacrificial collar **116**; and forming a capacitor in the lower portion. As disclosed in col. 4, lines 28-47, in an alternate embodiment, trench **110** is widened using a wet anisotropic etch process. In this alternate approach, hard mask **108** is employed to locate trenches **110** and after trench **110** is formed the trench sidewalls in the pad stack is widened relative to the hard mask by the etch process. Thus, by widening the trench sidewalls in the pad stack, the hard mask **108** inherently having an overhangs portion over the widened sidewalls of the trench. Thus, Kudelka teaches the Applicants' claimed invention.

For these reasons, Examiner holds the rejection proper.

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:00 AM - 5:00 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (571) 272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

K.N.

January 27<sup>th</sup>, 2005



**W. DAVID COLEMAN**  
**PRIMARY EXAMINER**